



Dipartimento di Informatica  
Università di Pisa

**K-linux**  
Embedded linux  
for industrial applications

*relatore*  
**Marco Cavallini**

KOAN SOFTWARE



## Tipico approccio a GNU/Linux Embedded

- ☒ Riducendo una distribuzione esistente
- ☒ Da zero *'from scratch'*

Klinux è una distribuzione GNU/Linux creata *'from scratch'*

### Motivazioni

- ☒ Maggiore controllo dei componenti
- ☒ Garanzia della riproducibilità
- ☒ Utilizzo non limitato a PC (x86)



## Klinux a confronto con altre soluzioni

	Klinux	DIY*	Altri
Full GPL	SI	SI	NO
Royalty free	SI	SI	forse
Toolchain	Cross CPU	Singola CPU	Singola CPU
Toolkit (KTX)	KTX	NO	alcuni
Real Time	RTAI / Xenomai	vari	alcuni
IDE	Anjuta / Eclipse	varie	alcuni
GUI	SI	vari	NO
Time to market	giorni	settimane	dipende
Supporto	SI	NO	alcuni

\*Do It Yourself



## Vantaggi di Klinux vs. DIY (Do It Yourself)

- ❑ Entrambi basati su componenti GPL (GNU/Linux)
- ❑ Selezione dei componenti
- ❑ Integrazione di librerie e applicativi
- ❑ Con server grafico Xfree86
- ❑ Time to market
- ❑ Supporto e assistenza (a pagamento)

*Klinux offre i vantaggi  
di una distribuzione proprietaria (supporto)  
e quelli di una distribuzione GPL (open source)*



## Perchè è nata Klinux

- ❑ Embedded e Real-Time
- ❑ Kernel 2.4.x
- ❑ Modulare e configurabile con un Toolkit
- ❑ Completa di tools di sviluppo
- ❑ Con server grafico Xfree86
- ❑ Libreria grafica
- ❑ Supporto e assistenza in italiano





## Caratteristiche di Klinux

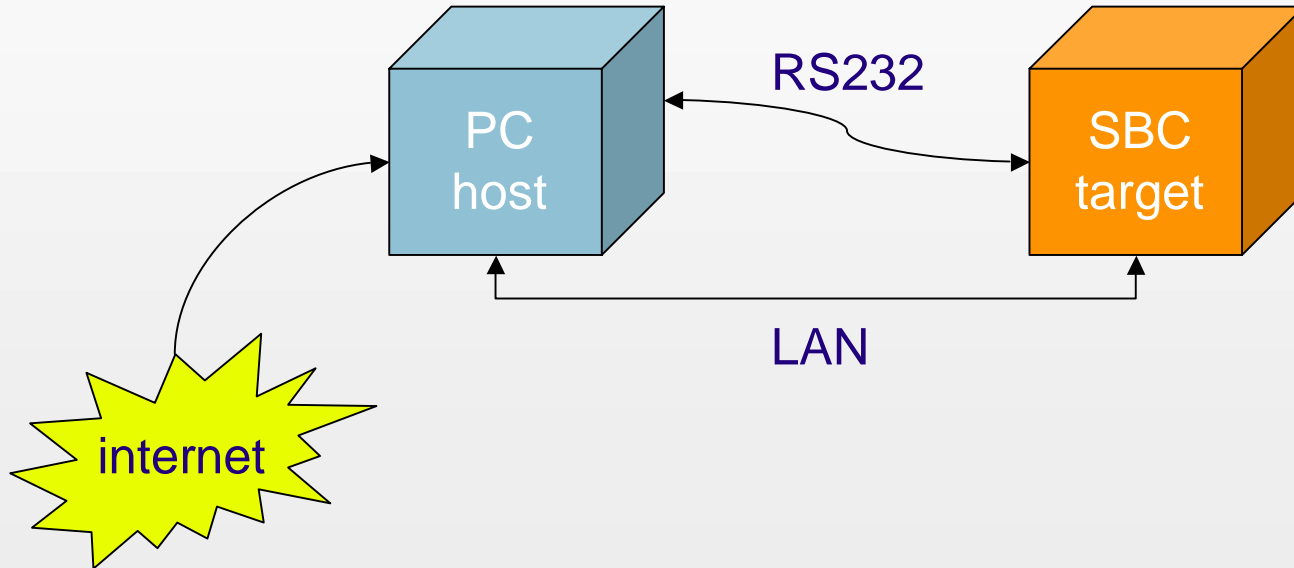


## Architettura e Requisiti

(4 diapo)



## Architettura per lo sviluppo

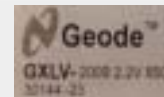




## Processori target supportati

- ❑ ARM con MMU
- ❑ ARM senza MMU
- ❑ X86
- ❑ PPC\*
- ❑ ColdFire\*
- ❑ MIPS\*
- ❑ SuperH\*

\*opzionali







## Requisiti minimi di Klinux ...

### PC con distribuzione linux per sviluppo

- ❑ Fedora Core\*
- ❑ Debian\*
- ❑ Ubuntu
- ❑ RedHat
- ❑ Slackware
- ❑ ...altre

\*consigliate





## Requisiti minimi di Klinux ...

### Kernel e filesystem senza grafica

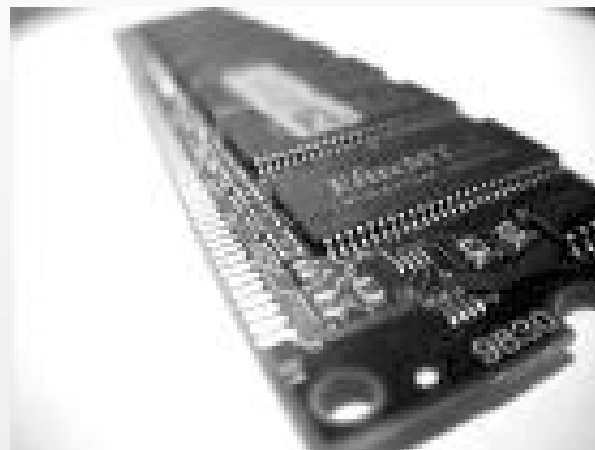
- ☒ 4MB ROM (disco o flash)
- ☒ 4MB RAM

### con grafica TinyX

- ☒ 16MB ROM
- ☒ 16/32MB RAM

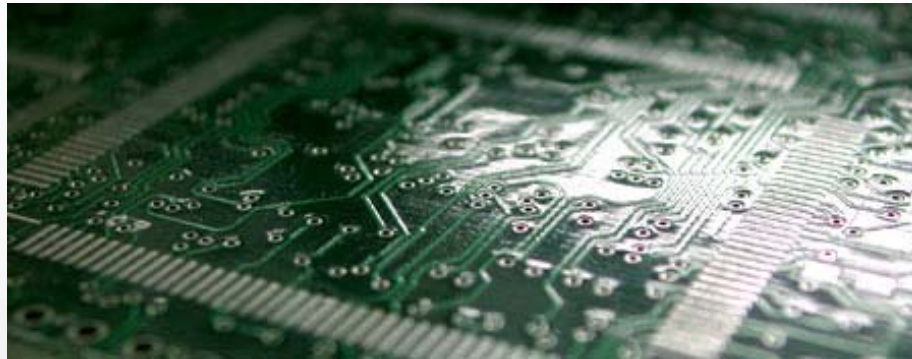
### con grafica TinyX e wxWidgets-GTK

- ☒ >64MB ROM
- ☒ 128MB RAM





## Caratteristiche di Klinux



### KTX

Koan Toolkit eXtension  
il tool di configurazione

(15 diapo)



## Configurazione con KTX ...

### Selezione modulare dei componenti

- Target options
- Cross toolchain
- Root filesystem
- Debugging tools
- Kernel version
- RTAI extension
- C library





## Configurazione con KTX ...

### Supporto CPU

- X86
- ARM MMU
- ARM noMMU
- PPC
- MIPS\*
- SuperH\*

\*opzionali

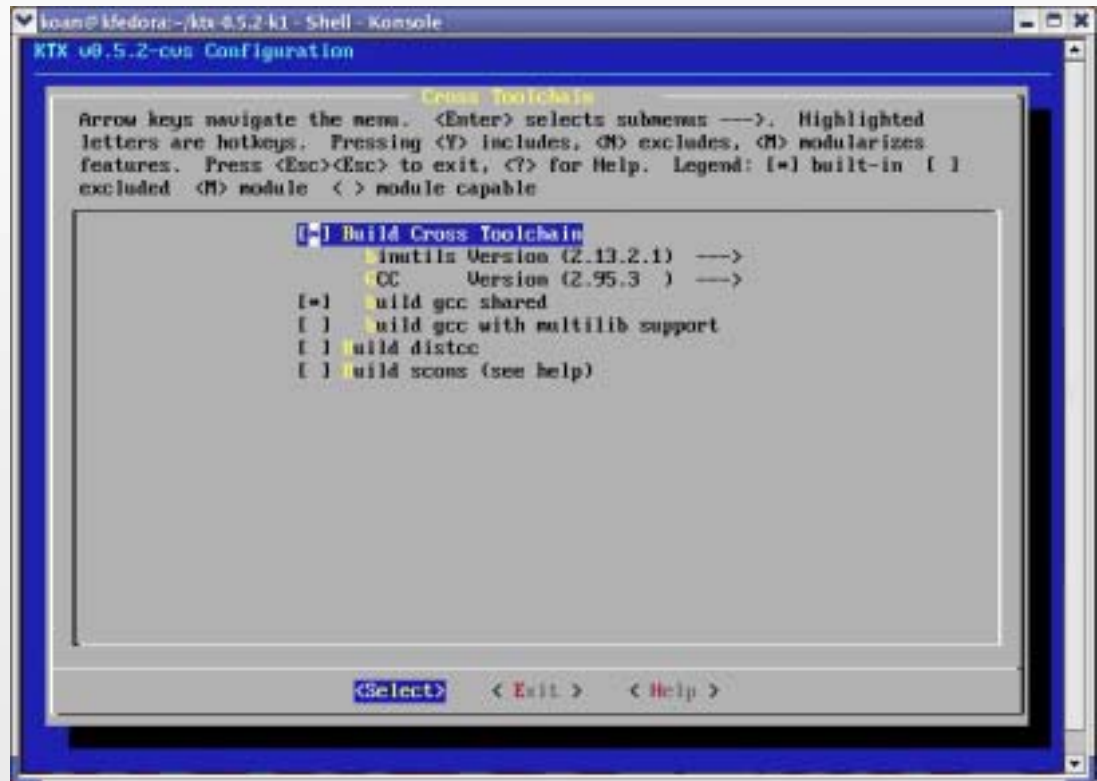




## Configurazione con KTX ...

### Creazione della Toolchain

- gcc-2.95.3
- gcc-3.2.3
- gcc-3.3.3
- gcc-3.4.1
- gcc-3.4.2
- glibc-2.2.5
- glibc-2.3.2
- glibc-2.3.3
- binutils-2.13.2.1
- binutils-2.14





## Configurazione con KTX ...

### Creazione del root filesystem

- /proc
- /home
- /dev
- /mnt
- /tmp
- /var
- Personalizzazione

```
koan@Medora:~/ktx-0.5.2.k1 - Shell - Konsole
KTX u0.5.2-cus Configuration

                                Root Filesystem
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*) built-in [ ]
excluded <M> module < > module capable

[*] Create /proc
[*] Create /dev
[*] Create /mnt
[*] Create /tmp
[*] Create /home
[*] Create /var
(koan-populate) Run vendor Makefile at the end of build

<Select> < Exit > < Help >
```



## Configurazione con KTX ...

### Supporto per debug

- basato su GDB**
- gdbserver**
- cross-gdb**
- ksymoops**
- strace**

```
koan@Medora:~/ktx-0.5.2-41 - Shell - Konsole
KTX v0.5.2-cus Configuration

          Debugging Tools
arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [=] built-in [ ]
excluded <M> module <> module capable

[=] build Cross GDB
[=] build gdbserver for target
[=] build shared (NEW)
[ ] build GDB for target
[ ] build cross-GDB wrapper
[=] ksymoops
[ ] Linux Trace Toolkit (LTT)
[ ] libbfd on target (needed for profiling)
[ ] mtest
[ ] profile
[=] strace
[=] build shared

[Select] < Exit > < Help >
```

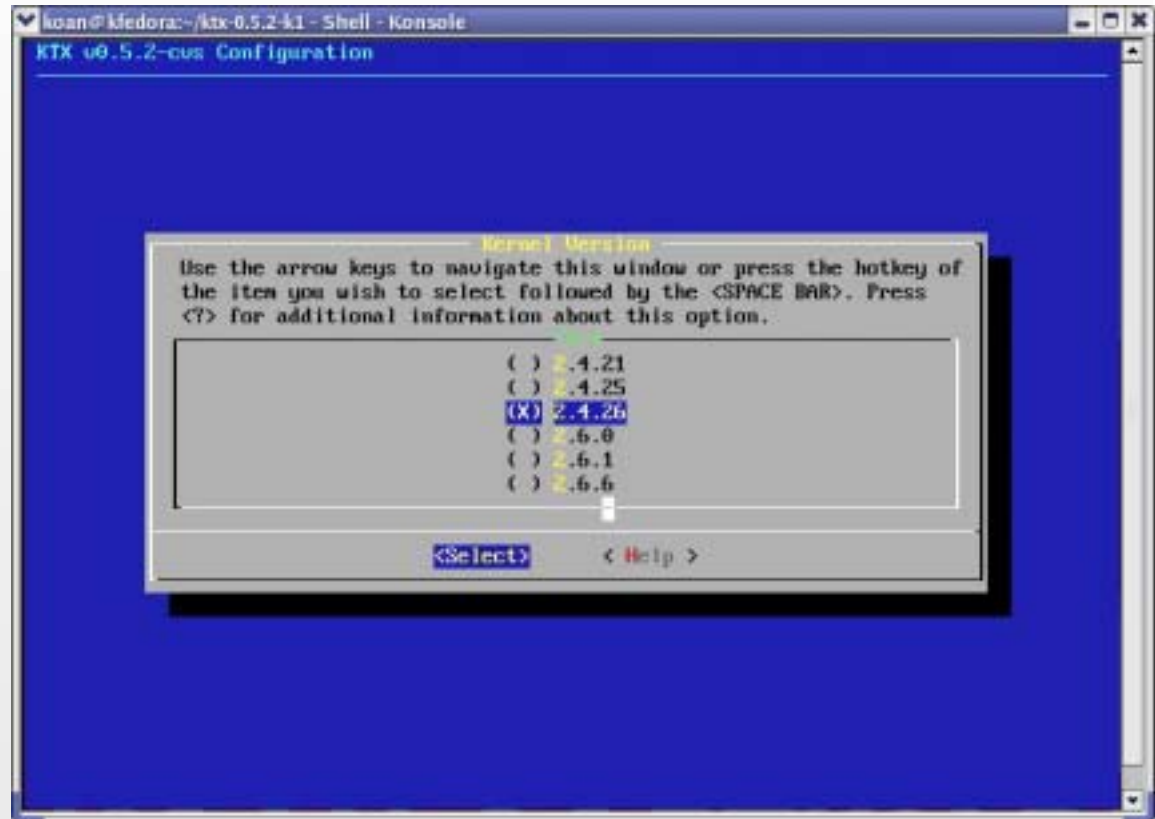




## Configurazione con KTX ...

### Versione del Kernel

- fino a 2.4.27
- fino a 2.6.11





## Configurazione con KTX ...

### Opzioni del Kernel

- zImage**
- ulImage**
- vmlinux**
- bzImage\***

\*solo x86

```
kooan@fedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

Kernel
Arrow keys navigate the menu. <Enter> selects submenus -->. Highlighted
letters are hotkeys. Pressing <Y> includes, <O> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

(kernel-2.4.19-1386-generic-20030808-1) Name of config in $KTX/config/kernel to
Kernel Version (2.4.26) -->
[ ] Don't compile kernel
Kernel Image (zImage) -->
[*] Install kernel into /boot on target
-----
() Patch 1 URL
() Patch 1 Name
--- Extensions
--- RTAI/epoll should be ported to patchstack mechanism, please send patch! :->
[*] RTAI -->

< Select > < Exit > < Help >
```



## Configurazione con KTX ...

### Estensioni Real-Time

- basato su RTAI
- rta-3.1 vesuvio
- RTAI/fusion-0.9.1
- Xenomai

```
koan@Medora:~/ktx-0.5.2-41 - Shell - Konsole
KTX v0.5.2-cus Configuration

                                RTAI
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module <> module capable

[*] Realtime Extension: RTAI
(rtai-24.1.10-) None of config in $KTX/config/rtai to be used
  RTAI Version (24.1.12) --->
  Select RTAI technology
[*] Real-Time Networking for RTAI
[ ] build 3Com 59x driver (see help)
[ ] build Realtek 8139 driver
[*] build Intel EtherExpressPro/100 driver
[ ] build AMD PCnet32 driver
[ ] build VIA Rhine driver
[ ] build loopback driver
[ ] build tulip driver

<Select>  < Exit >  < Help >
```



## Configurazione con KTX ...

### C library

- completa selezione delle opzioni di configurazione della compilazione

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs: Configuration

--- C Library
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <M> module < > module capable

  Which C library do you want to use? (GLIBC) --->
--- C Library options
[*] C-Lib Version (2.3.2) --->
[*] compile glibc with pthreads
[ ] build in GNU libio instead of GNU stdio
[*] build shared library
[ ] include profiling support
[ ] build undebuggable optimized library
[ ] build with runtime bounds checking
[ ] optimize glibc for selected kernel version
[ ] don't strip debugging symbols
--- Install options
[*] install libthread_db on the target
[*] install libdl on the target
[*] install libcrypt on the target
[*] install libutil on the target
[*] install libn on the target
[*] install libnss_dns

[Select] < Exit > < Help >
```



## Configurazione con KTX ...

### uClibc

- uClibc per processori senza MMU





## Configurazione con KTX ...

### Busybox

- completa selezione delle opzioni di configurazione

```
koan@kfedora:~/ktx-0.5.2-kl - Shell - Konsole
KTX v0.5.2-cvs Configuration

BusyBox
Arrow keys navigate the menu. <Enter> selects submenus --->. Highlighted
letters are hotkeys. Pressing <Y> includes, <O> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help. Legend: [*] built-in [ ]
excluded <O> module < > module capable

[*] Compile BusyBox
General Configuration --->
Build Options --->
Archival Utilities --->
Coreutils --->
Console Utilities --->
Lebian Utilities --->
Editors --->
Finding Utilities --->
Init Utilities --->
Login/Password Management Utilities --->
Miscellaneous Utilities --->
Linux Module Utilities --->
Networking Utilities --->
Process Utilities --->
Another Bourne-like Shell --->
System Logging Utilities --->
Linux System Utilities --->

<Select> <Exit> <Help>
```



## Configurazione con KTX ...

### Network security

- OpenSSL
- OpenSSH

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs: Configuration

Network Security
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [=] built-in [ ] excluded <M> module < > module capable

shorewall firewall --->
LSH --->
OpenSSL --->
OpenSSH --->
Dropbear SSH-Server --->

<Select> < Exit > < Help >
```



## Configurazione con KTX ...

### Applicazioni networking

- ppp
- nmap
- utelnetd
- inetutils
- netcat
- proftpd
- nfs-utils
- wireless tools

The screenshot shows a terminal window titled "koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole" with the "KTX v0.5.2-cvs Configuration" window open. The window displays a "Networking Apps" menu with the following items: "bing" (highlighted), "PPP", "nmap", "utelnetd", "inetutils", "netcat", "proftpd", "betaftpd", "nfs-utils", "Portmapper", "tcpwrapper", "Wireless Tools", "GNU Zebra", and "libnet". Each item has a right-pointing arrow. Below the menu, there are three buttons: "<Select>", "< Exit >", and "< Help >".





## Configurazione con KTX ...

### Grafica

- Xfree86
- TinyX
- GTK
- Fltk GUI
- wxWidgets GUI
- Qt/embedded\*
- Blackbox WM

\*unstable

```
koan@kfedora:~/ktx-0.5.2-kl - Shell - Konsole
KTX v0.5.2-cus Configuration

Graphics Libraries
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [*] built-in [ ] excluded <M> module < > module capable

glib-1.2.10  --->
gtk-1.2.10   --->
glib-2.2.2   --->
gtk-2.4.2   --->
Free86-4.3.0 --->
Clementine WM --->
LTK GUI Toolkit --->
wxWidgets GUI --->
Qt embedded GUI --->
Blackbox WM  --->

<Select>  < Exit >  < Help >
```



## Configurazione con KTX ...

### Pseudo Java™ VM

- Kaffe VM
- completa selezione delle opzioni di configurazione

```
koan@kfedora:~/ktx-0.5.2-k1 - Shell - Konsole
KTX v0.5.2-cvs Configuration

      Kaffe
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help.
Legend: [*] built-in [ ] excluded <M> module < > module capable

[*] Compile Kaffe
--- Target Options
  Engine (JITv3) --->
  Threading System (unix-jthreads) --->
  API (J2SE) --->
[ ] Use Jikes or other Java compiler (NEW)
--- Debugging Options
[ ] Enable run-time debugging machinery (NEW)
[ ] Enable debugging symbol generation for jitted code (xdebugging)
[ ] Compile with gprof(1) profiling support (NEW)
[ ] Enable profiling for C and jitted code (xprofiling) (NEW)
[ ] Gather statistics on vm execution (NEW)
--- Features
[ ] Enable GCJ support (NEW)

<Select> < Exit > < Help >
```



## Caratteristiche di Klinux



### **BSP**

**B**oard **S**upport **P**ackage  
esempio di piattaforme  
preconfigurate

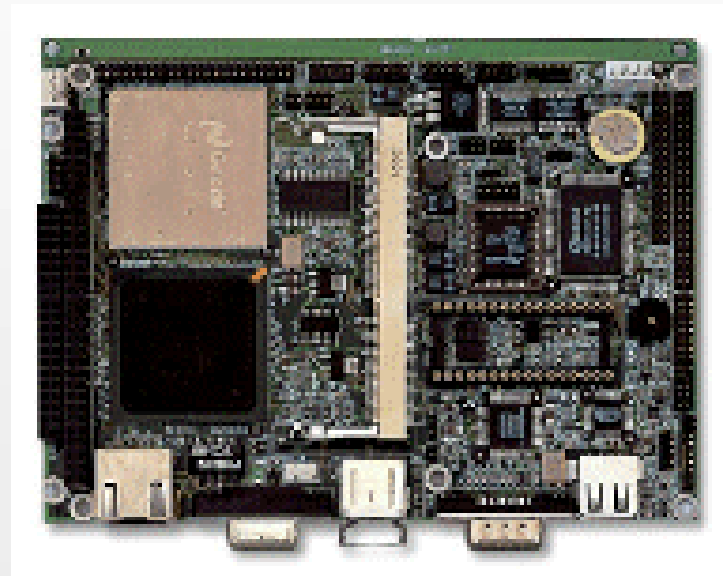
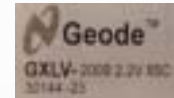
(5 diapo)



## BSP di Klinux ...

### Boser HS2603 (e altre)

- ❑ **Cyrix Geode GX1/CX5530**
- ❑ **SO-DIMM 128MB**
- ❑ **I/O Chipset: SMC 37C669, Winbond W83977**
- ❑ **VGA Cyrix CX5530**
- ❑ **LAN 10/100 Realtek**
- ❑ **Audio Cyrix CX5530**
- ❑ **IDE, FDD, Parallel, 4 Serial**
- ❑ **PC/104 connector 16-bit ISA**
- ❑ **USB 1.1 ports (12Mbit/s)**



Klinux certified



## BSP di Klinux ...

### Icop Vortex86 (tutti)

- ❑ Vortex86 166 MHz SoC
- ❑ Memory 128MB
- ❑ VGA
- ❑ LAN 10/100 Realtek
- ❑ IDE, FDD, Parallel, 2 Serial
- ❑ PC/104
- ❑ USB 1.1 ports (12Mbit/s)



Klinux certified

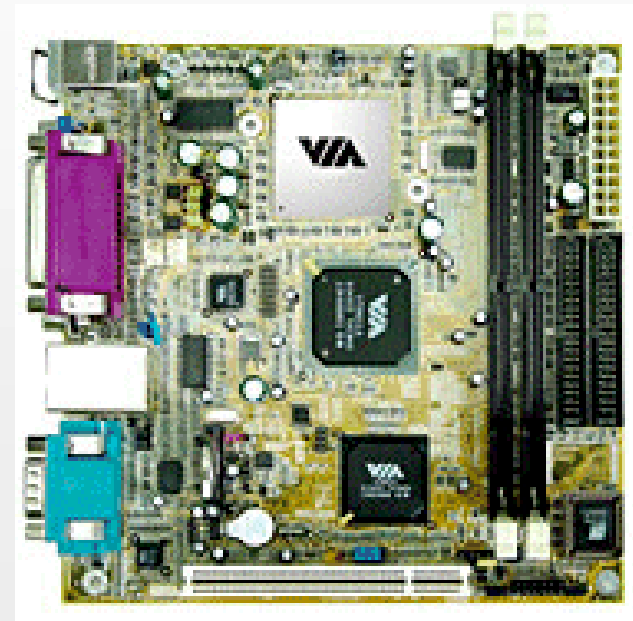


## BSP di Klinux ...



### VIA EPIA Mini ITX

- ❑ VIA C3/EDEN 133MHz
- ❑ 1 DDR266 DIMM socket
- ❑ VGA
- ❑ LAN 10/100 Realtek
- ❑ 1 PCI Expansion Slots
- ❑ IDE, FDD, Parallel, 1 Serial
- ❑ USB 2



Klinux certified

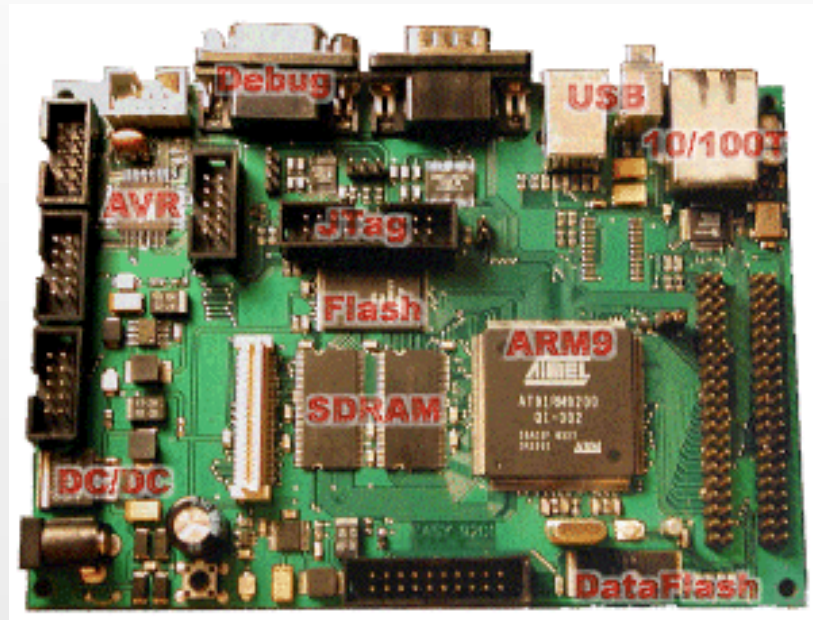


## BSP di Klinux ...



### Easy9201

- ❑ Atmel ARM AT91RM9200
- ❑ +AVR ATmega
- ❑ 32MB SDRAM
- ❑ 2MB parallel flash
- ❑ 4MB serial flash
- ❑ RS232
- ❑ LAN 10/100
- ❑ USB 2 Host
- ❑ USB 2 Device
- ❑ JTAG



Klinux certified

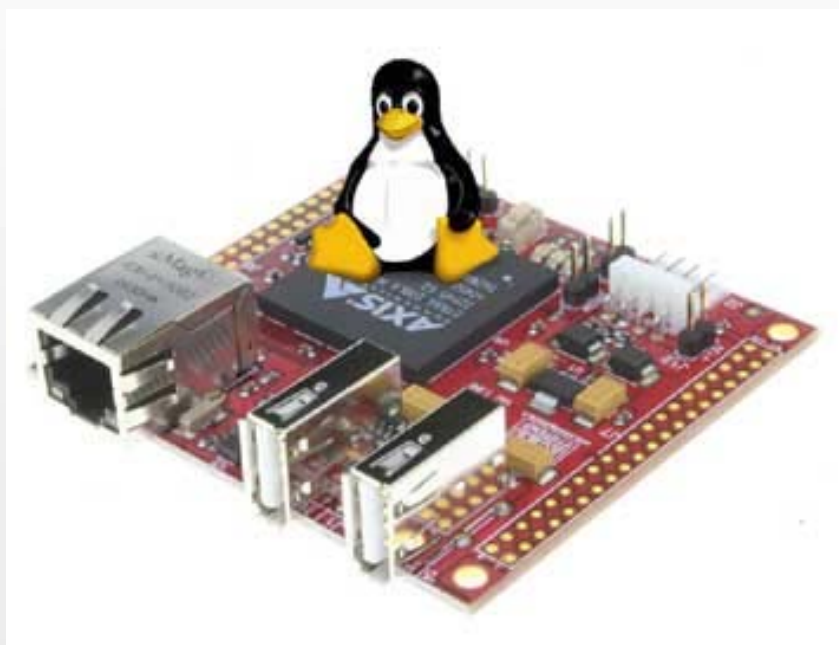


## BSP di Klinux ...

### FOX Board\*

- ❑ **AXIS Etrax SoC**
- ❑ **32 bit RISC CPU core**
- ❑ **10/100 MBit Ethernet**
- ❑ **4 async serial ports**
- ❑ **2 sync serial ports**
- ❑ **2 USB ports**
- ❑ **2 Parallel ports**
- ❑ **4 ATA (IDE) ports**

\*Q1 2006



Klinux certified





## BSP di Klinux ...

Sviluppo personalizzato per  
schede OEM



- ❑ Porting di Linux su nuove piattaforme
- ❑ Sviluppo kernel device drivers
- ❑ X11 e graphics device drivers
- ❑ User space drivers

Klinux certified



## Caratteristiche di Klinux



### IDE

Integrated **D**evelopment **E**nvironment  
sviluppo e debugging

(3 diapo)



## Anjuta IDE ...

Fully customizable integrated editor

- ❑ Automatic syntax highlighting
- ❑ Automatic code formatting
- ❑ Code folding/hiding
- ❑ Line numbers/markers display
- ❑ Text zooming
- ❑ Code autocompletion
- ❑ Automatic indentation and indentation guides
- ❑ ... and much more.

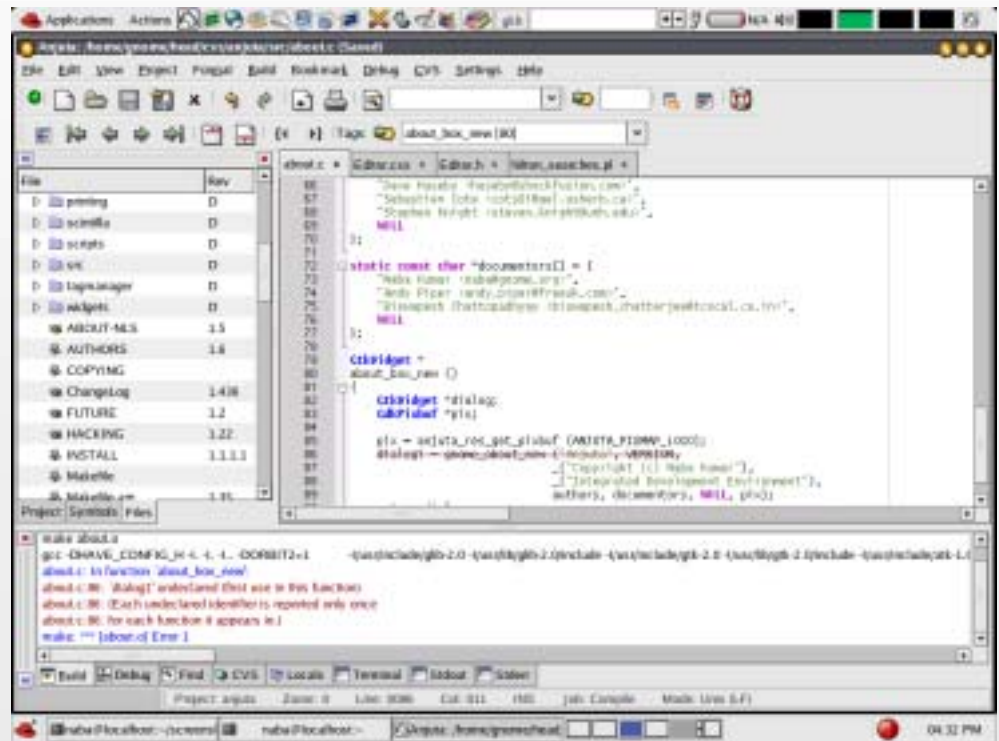




## Anjuta IDE ...

### Debugger grafico

- █ **Highly interactive source-level debugger** (built over gdb)
- █ **Interactive execution**
- █ **Breakpoints manipulation**
- █ **Watches manipulation**
- █ **Signal manipulation**
- █ **Stack manipulation**
- █ **... and much more.**

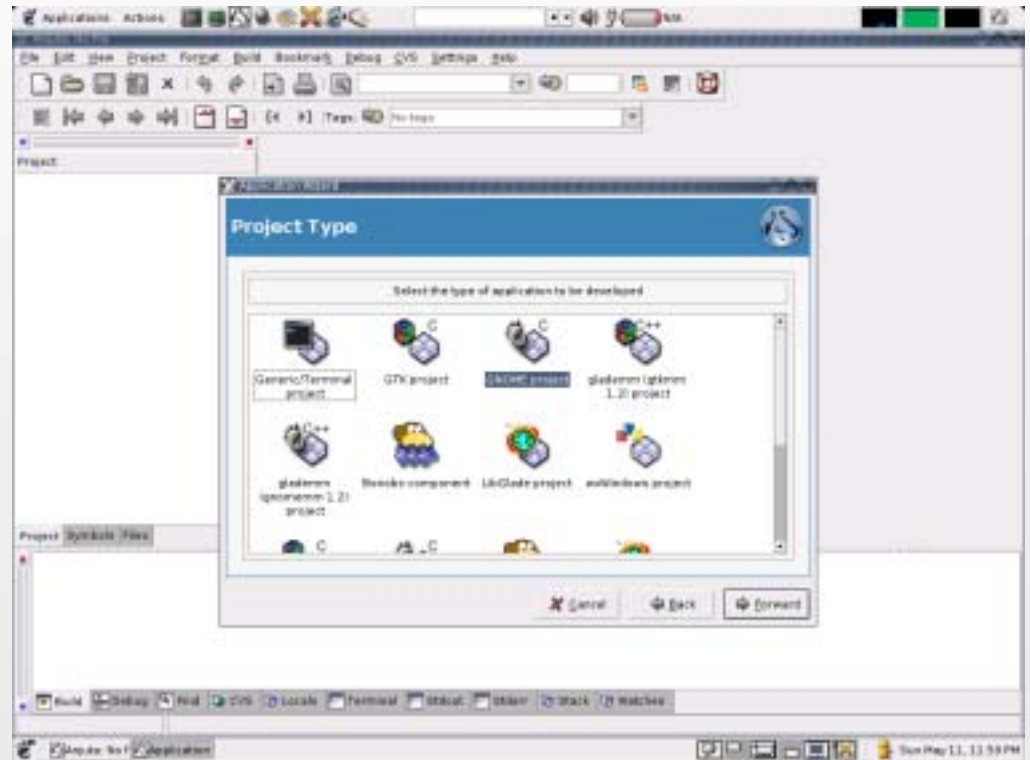




## Anjuta IDE ...

### Wizards

- ❑ Terminal applications
- ❑ Gtk applications
- ❑ Gnome applications
- ❑ wxWidgets applications





## Caratteristiche di Klinux



### Varie

Bootloader, Librerie grafiche, Versioni

(4 diapo)

## Bootloaders

- ❑ GRUB
- ❑ LILO
- ❑ U-boot
- ❑ Blob
- ❑ ...altri\*



realizzazione bootloaders personalizzati



## Librerie grafiche

- ❑ Xfree86
- ❑ wxWidgets
- ❑ Qt/X11
- ❑ Qt/embedded
- ❑ Fltk
- ❑ ...altre

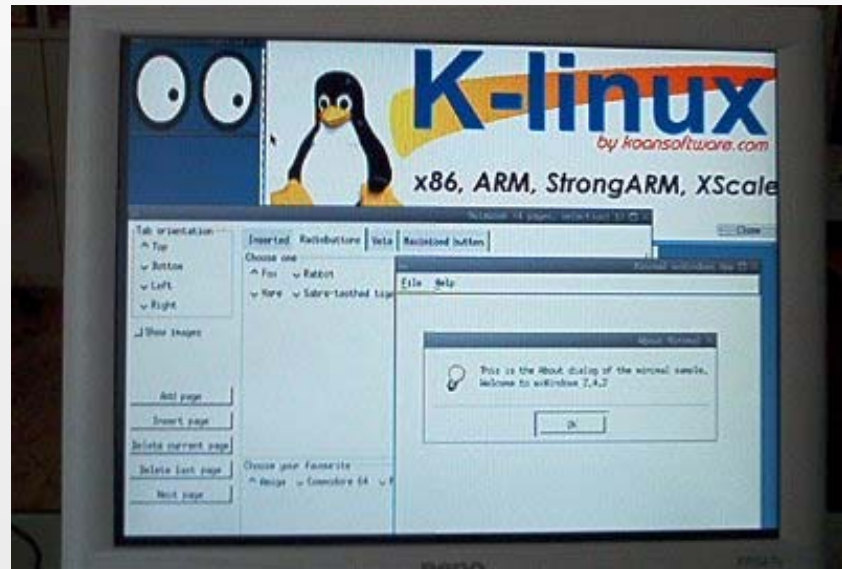






## Librerie grafiche

Supporto per librerie wxWidgets integrato in Klinux  
a partire dalla versione Gold





## Settori di utilizzo

- ▣ Automazione industriale
- ▣ Controllo presse ad iniezione (con Xenomai)
- ▣ Automotive per Diagnosi motori
- ▣ Controllo accessi
- ▣ Video-citofonia
- ▣ ecc...



## Alcuni degli utenti Klinux

- ▣ INFN laboratori di nazionali di Frascati
- ▣ CNR Bari
- ▣ ecc...



## Futuro di Klinux

- ❑ **Versione 3.0 (Q1 / 2006)**
- ❑ **Nuovo Toolkit KTX grafico**
- ❑ **Integrazione Xenomai**
- ❑ **Integrazione migliorata RTAI**
- ❑ **Integrazione JavaVM™**
- ❑ **Nuovo IDE con debugging remoto**

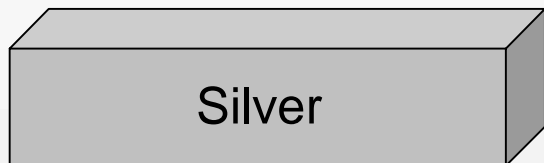




## Versioni di Klinux



- CD con software e documentazione



- CD con software e documentazione
- Supporto email e Aggiornamento



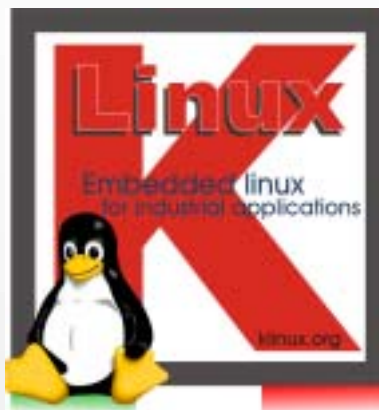
- CD con software e documentazione
- Supporto email e Aggiornamento
- 3 giorni di consulenza



- CD software documentazione
- Supporto, Aggiornamento
- Consulenza a progetto



**Grazie per l'attenzione**



*[m.cavallini@koansoftware.com](mailto:m.cavallini@koansoftware.com)*

**La presentazione sarà disponibile sul sito**

**[ftp.KoanSoftware.com](ftp://KoanSoftware.com)**